

CHM 102

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MECHATRONICS ENGINEERING

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CARBOXYLIC ACID

1 Give the IUPAC Names of the following compounds

1 HCOOH - methanoic acid

2 $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ - Pentan-1,5-dioic acid

3 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ - Butanoic acid

4 HOOC-COOH - Ethanedioic acid

5 $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ - hexanoic acid

6 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ - ~~hexan-4-enoic~~
hexan-4-enoic acid.

2 Discuss Briefly the physical properties of carboxylic acids under the following headings:

i) Physical Appearance

All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most other carboxylic acids are solid at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

ii) Boiling Point

Boiling point increases with increasing relative

molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

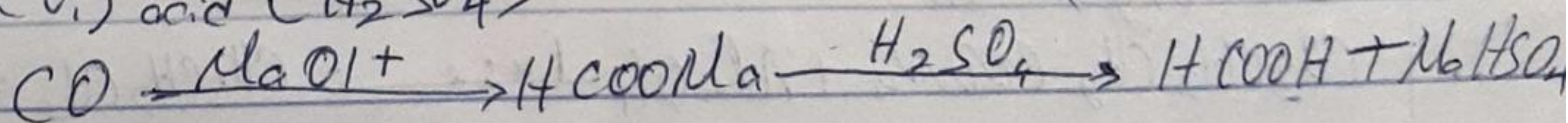
iii) Solubility

Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this is largely due to their ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent.

3 Write two industrial preparations of carboxylic acids

1 From Carbon (II) oxide

Methanoic acid (formic acid) is manufactured by adding carbon (II) oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate (VI) acid (H_2SO_4)



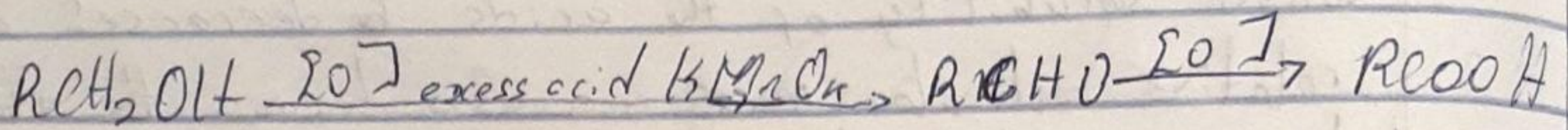
2 from petroleum

Liquid phase air oxidation C_5-C_7 alkanes, obtainable from petroleum at high temperature and pressure will give C_5-C_7 carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.

$C_5 - C_7 - O_2$ / High temp and pressure \rightarrow $C_5 - C_7$ carboxylic acids

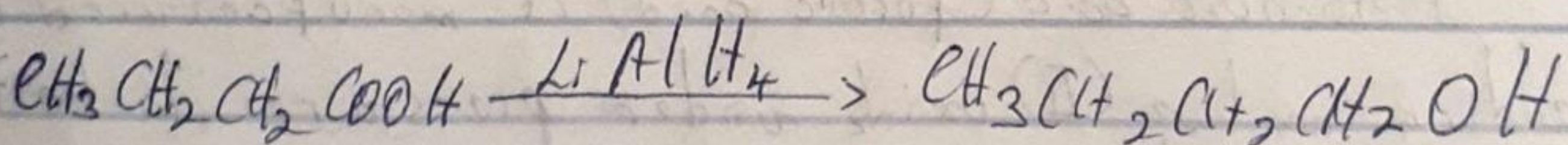
4. With equations and brief explanation, discuss the synthetic preparation of carboxylic acids.

Oxidation of primary alcohols and aldehydes
Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents like $K_2Cr_2O_7$ or $KMnO_4$ in acidic solution

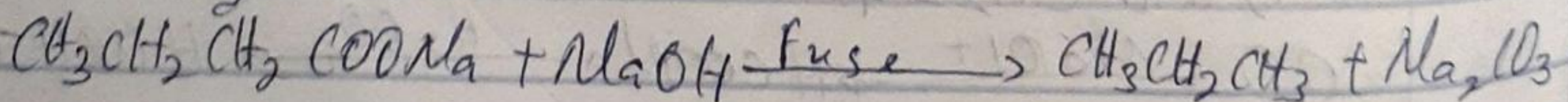


5. With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

i) Reduction of primary alcohol



ii) Decarboxylation



iii) Esterification

